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(54) Improved regenerative thermal oxidizer

(57) A regenerative thermal oxidizer (RTO) is constructed to receive polluted waste gases from an industrial process, cleanse the gas and permit cleansed gas to exit the RTO to the environment. The RTO includes a lower section (18) having an inlet to receive polluted or incoming gas, and a centrally positioned rotary distributor (20) in the lower section for cooperation in controlling gas flow via a segmented center section. The rotary distributor is substantially smaller than the lower section and is of a substantially smaller cross section. Incoming gas is directed to a middle section segment (s), fills the segment(s) and then flows through a peripheral opening to a segmented upper section (30) where it passes through a heat exchanger (38) to a combustion chamber where it is oxidized or cleansed. From there cleansed gas passes through another upper section segment (40) through a heat exchanger (42) and back to center section segment(s). In the center section the cleansed gas flows to the rotary distributor where it is divided into outgoing and purge gases. The outgoing gas flows through the rotor to a manifold and then to an outlet. The purge gas flows through a purge segment in the rotor to a center discharge pipe. From the pipe the purge gas is directed to a conduit for exiting the RTO and the purge gas is then recycled to the incoming gas to the RTO.

FIG. 4

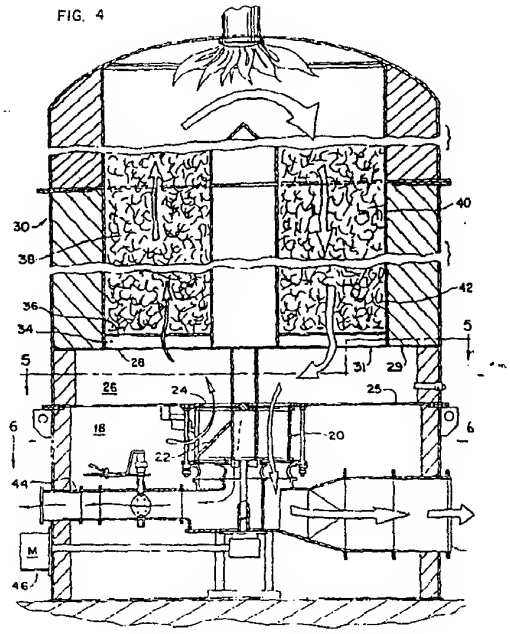

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FIG. 1

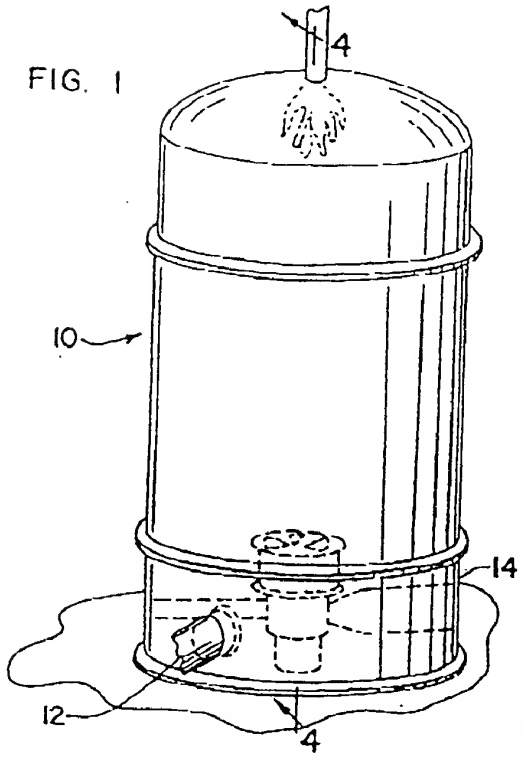


FIG. 3

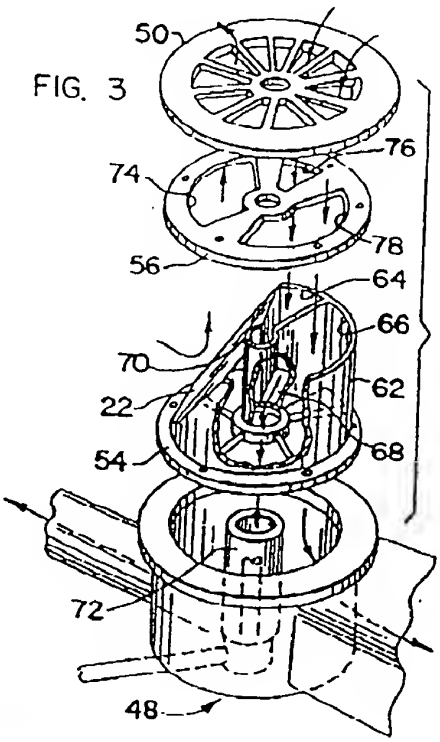
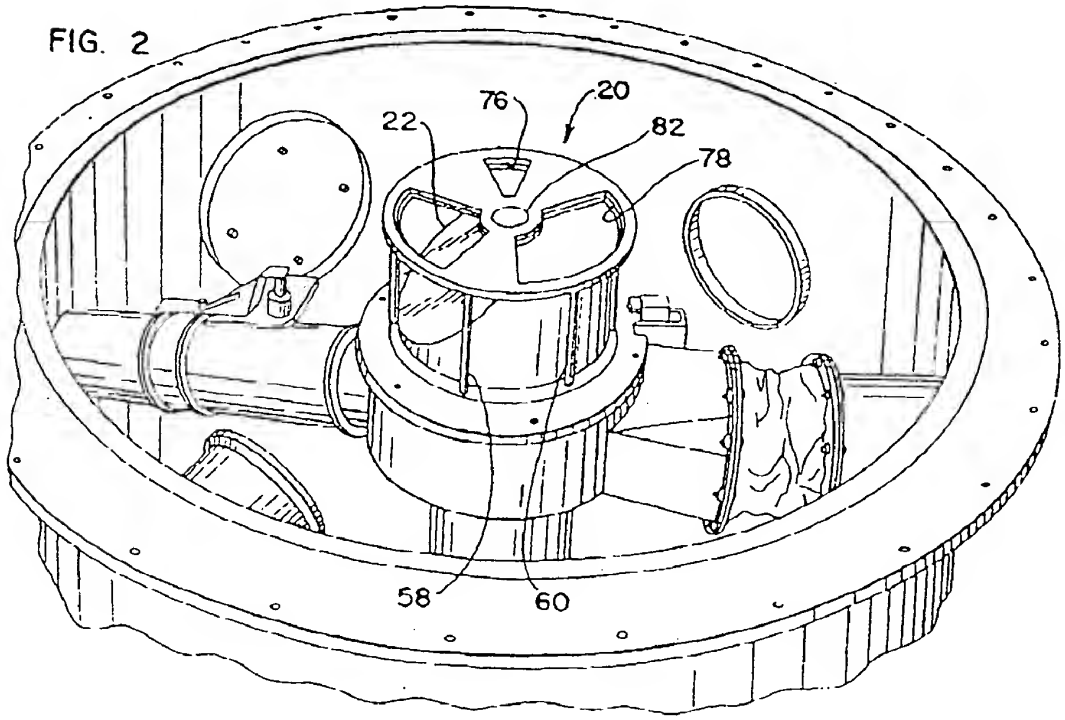


FIG. 2



segment 64. The outgoing gas aperture 78 is aligned with the remainder of the rotor and not the purge aperture 64 or deflection plate 22.

The grate 50 fits in the plate 25 at the center 26, and the plate divides the lover section and middle section. The grate defines the openings through which incoming gas enters the center section and outgoing gas and purge gas exits the center section. The grate is segmented and the grate segments are aligned with the section segments.

Operation

In operation, incoming gas fills the lower section 18 and is deflected by plate 22 through the grate to the center section. The incoming gas fills center section segments and flows to the upper section and the combustion chamber. At the combustion chamber the polluted ga8 is cleansed to form outgoing gas and from the combustion chamber, outgoing or cleansed gas flows through the upper section segments, to the center section segments and to the center grate 50. Outgoing gas flows through the grate 50, a small portion of the gas flows to the purge aperture 76 and the rest to the outgoing gas aperture 78. The outgoing gas fills the body 54, flows through the body bottom, to the manifold 48 and then flows to the exit 14 via conduit 80.

Some cleansed gas enters the purge aperture 76, flows into the purge segment 64 and to the center pipe 70. At the pipe, the gas flows downwardly to the conduit 72 and out through the purge conduit 44. It will be noted that the purge gas cannot flow upwardly in the center pipe as the top of the pipe is closed off by a plug-like construction 82.

As the distributor is rotated, the incoming, purge and outgoing gas flow to and from different center section segments.

The incoming gas is healed by the heat exchange qranules which have been heated by the outgoing gas when it passed downwardly through an upper section segment which is now used for incoming gas. Thus, the outgoing gas looses heat to the heat exchange granules as it passes from the combustion chamber to the center section and incoming gas picks up heat.

In this embodiment, the distributor is rotating counter clockwise and thus the purge aperture 76 leads the outgoing gas aperture 78 so that the purge segment captures the beginning portion of the outgoing gas and thus minimizes the contaminant content of the outgoing gas that exits the system. The purge gas is normally directed back to the incoming gas and is in a sense recycled through the system.

Numerous changes and modifications can be made to the embodiment disclosed herein without departing from the spirit and scope of the invention.

Claims

1. A regenerative thermal oxidizer which includes:

   an elongated housing which includes a lower section, a center section and an upper section; the lower section includes an incoming gas inlet, a purge gas outlet and an outgoing gas outlet;

   a rotary distributor centrally positioned in the lower section, for cooperation in transmitting gas between the lower section and the center section and for defining purge and outgoing gas sections;

   the center section constructed and positioned between the upper and lower sections to define a plurality of segments, to receive incoming gas to transmit incoming gas to a segmented upper section, and to receive cleansed gas from said upper section and transmit it to purge and outgoing gas portions of the rotary distributor;

   said upper section defining a plurality of segments aligned with the center section segments and a combustion chamber at the top thereof;

   heat exchanger material positioned in each segment of the upper section whereby pollutant-containing incoming gas can pass through the heat exchanger material in a segment and cleansed gas after burning in the combustion chamber can pass through the heat exchanger material in a segment; and

   said upper section constructed to receive polluted gas from the center section and discharge cleansed gas to said center section.

2. A regenerative thermal oxidizer as in claim 1 which includes said center section having a first partition or wall-like surface that separates the center section and lower section and which defines a centrally positioned opening which is substantially smaller in cross section than the cross section of the housing and adjacent said rotary distributor and a second partition wall-like surface that separates the center section and the upper section which defines a plurality of openings, each opening associated with a segment and each opening positioned adjacent the periphery of the housing whereby gas is caused to flow in the center section, between the center opening and the openings adjacent the periphery of the housing.

3. A regenerative thermal oxidizer as in claim 1 wherein the rotary distributor includes a cylindrically-shaped body and an apertured disc-shaped distribution plate mounted on the body, which together control gas flow between the lower and center sections.

4. A regenerative thermal oxidizer as in claim 3 wherein said body defines an angular surface for deflecting incoming gas from the lower section toward the center opening to the center section, and said distribution plate includes an aperture aligned with the angular surface through which incoming polluted gas passes as it moves to the center section from the lower section.

5. A regenerative thermal oxidizer as in claim 3 wherein said body defines an open top and an open bottom chamber for directing outgoing cleansed gas from the center section to the outlet in the lower section, and said distribution plate includes an outgoing gas aperture aligned with the outgoing gas chamber through which outgoing gas from the center section to the lower section and the outlet.

6. A regenerative thermal oxidizer as in claim 5 wherein there is provided a manifold connected to the outgoing gas chamber bottom and the exits.

7. A regenerative thermal oxidizer as in claim 5 wherein said body defines a purge gas chamber, having an open top, a closed bottom and center conduit, whereby gas from the middle section flows through the purge chamber to the Center conduit and to a purge gas conduit outlet, and said distribution plate includes a purge gas aperture aligned with the purge gas chamber through which purge gas passes from the center section to the lower section.

8. A regenerative thermal oxidizer as in claim 1 wherein each peripheral opening defined in the portion wall separating the middle and upper sections provides communication between a middle section segment and an upper section segment.

9. A regenerative thermal oxidizer which includes:

an elongated housing which includes a lower section, a center section and an upper section;
the lower section includes an incoming gas inlet, a purge gas outlet and an outgoing gas outlet;
a rotary distributor centrally positioned in the lower section for cooperation in transmitting gas betwen the lower section and the center section. and for defining purge and outgoing gas sections.
said center section constructed and positioned between the upper and lower sections to define a plurality of segments, to receive incoming gas to transmit incoming gas to a segmented upper section and receive cleansed gas from the upper section, and to transmit it to the purge and outgoing gas segments of the rotary distributor;
said upper section defining a plurality of segments aligned with the middle section segments and a combustion chamber at the top thereof;
heat exchanger material position in each segment whereby pollutant-containing gas can pass through the heat exchanger material in a segment and cleansed gas after burning in the combustion chamber can pass through the heat exchanger material in each segment;
said upper section constructed to receive polluted gas from the middle section and discharge cleansed gas to the middle section;
said center section having a first partition or wall-like surface that separates the center section and lower section which defines a centrally positioned opening which is substantially smaller than the cross section of the housing and a second partition or wall-like surface that separates the center section and the upper section which defines a plurality of openings, each opening associated with a segment and each opening positioned adjacent the periphery of the housing whereby gas is caused to flow in the center section between the center opening and the openings adjacent the periphery or the housing;
the rotary distributor includes a cylindrically-shaped body and a disc-shaped apertured distribution plate which together control the gas flow between the lower and center sections;
said body defines an angular surface for deflecting incoming gas from the lower section toward the center section and said distribution plate includes a aperture aligned with the angular surface through which the incoming polluted gas passes as it moves to the center section from the lower section; and
said body defines an open top and an open bottom chamber for directing outgoing cleansed gas from the center section to the outlet in the lower section, said distribution plate includes an outgoing gas aperture aligned with the outgoing gas chamber through which outgoing gas is passed from the center section to the lower section and the outlet;
there is provided a manifold connected to the outgoing gas chamber bottom and the exits;
said body defines a purge gas chamber. having an open top. a closed bottom and a center conduit whereby gas from the center section flows through the purge chamber to the center conduit and to a purge gas conduit outlet, and said distribution plate includes a purge gas aperture aligned with the purge gas chamber through which purge gas passes from the center section to the lower section and in the distributor plate the incoming gas aperture is positioned on one side of the center, the outgoing aperture is po-

sitioned on the other side of the center and the purge gas aperture is positioned between the incoming gas aperture and outgoing gas aperture and adjacent the outgoing gas aperture and the distributor plate is adapted to rotate in a direction;
whereby the incoming gas aperture leads the purge gas aperture which leads the outgoing gas apertures; and the three apertures are located approximately the same radial distance from the center of the rotor plate.

10. A method for cleansing polluted industrial gases, comprising the steps of:

providing a regenerative thermal oxidizer unit housing an elongated housing with lower, cantor and upper sections, with the lower section having an incoming polluted gas inlet, an outgoing cleansed gas outlet, a purge gas outlet and a rotary distributor for cooperation in controlling gas flow between the lower section and center section, each of said center and upper sections, said section defining a plurality of gas receiving segments, a first wall-like partition that separates the lower and middle section and having a central opening that cooperates with the rotary distributor in the passage of gas between the lower section and center section and a second wall-like partition that separates the center and the upper sections and which has a plurality of openings, one associated with each segment and position between the center opening and the periphery and adjacent the periphery;
causing incoming polluted gases to flow into the lower section of the RTO;
passing the incoming gas from the lower section to selected segments of the center section through the center aperture in the wall between the middle section and lower section;
causing the polluted gas to flow from the center of the middle section toward the periphery thereof;
causing the polluted gas to pass upwardly through a peripheral opening in the wall between the upper section and center section into the upper section segments:
flowing the polluted gas through heat exchanger material in an upper section segment to a combustion chamber for oxidation and cleansing;
flowing the cleansed gas downwardly through selected segments of the upper section to the peripheral opening in the upper section/lower section wall;
flowing cleansed gas from the periphery of the middle section to the center opening of the middle sections;
separating the cleansed gas into a purge gas portion and an outgoing gas portion in the lower section;
flowing the outgoing gas through the lower section to an outlet; and
flowing the purge gas through the lower section to a purge outlet.